# AGRICULTURAL Research

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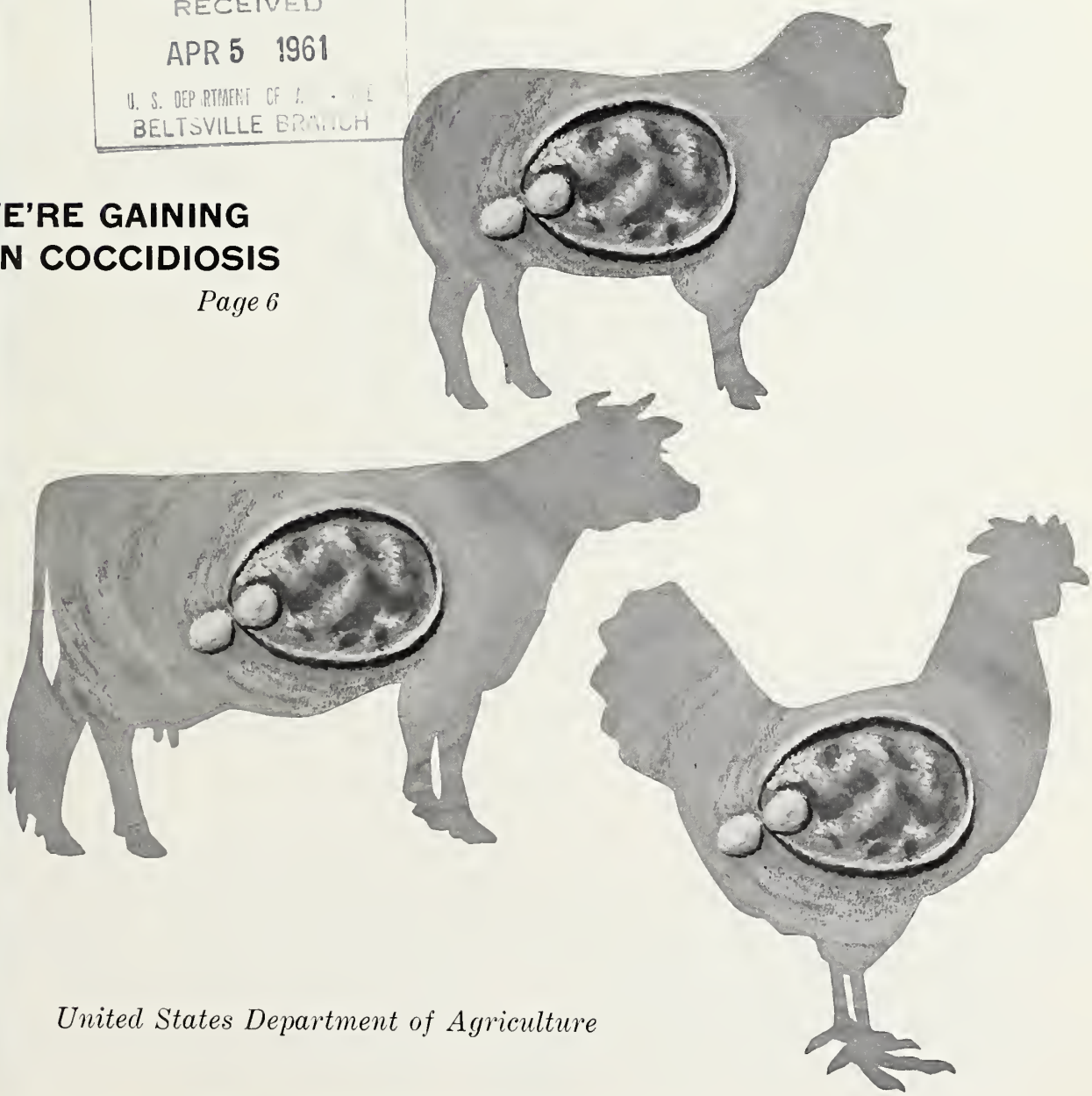
## WE'RE GAINING ON COCCIDIOSIS





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## Husbandry

Changes in the livestock industry, dramatic in the past quarter-century, may be more spectacular in the future.

Science and technology will become even more important in breeding, feeding, and management. We already have many clues on what's ahead. For example:

Continued consumer preference for meatier pork chops will mean advances in breeding meat-type hogs. We expect progress toward development of meat-type steers and lambs. Meat technologists will continue basic studies to determine accurately the ratio of fat, lean, and bone in the live animal. Farmers in turn will raise stock to meet consumer needs.

Factors affecting tenderness will be thoroughly investigated. We already know tenderness is highly heritable. It will be of growing importance in selection of breeding stock.

Performance testing, an aid to selection of superior stock, will probably expand to include more tests conducted on farms. Artificial insemination, so valuable in upgrading dairy herds, will be used more and more for meat animals.

Basic research will continue—perhaps there will be applied results—on control of breeding cycles, control of sex in offspring, and use of frozen semen. The safe use of antibiotics, hormones, and tranquilizers, and perhaps other new feed additives will probably expand. Pelleting certain feeds is apt to become commonplace. Use of feed by livestock will continue to become more efficient.

Automation in handling feed and chores will increase. Less feed will be moved by hand. Motors, mixers, augers, endless belts, and the like will replace scoop shovels and forks.

New building materials and construction methods will speed adoption of improved management. There'll be more concrete floors and yards, air-conditioning, and labor-saving devices.

New marketing practices and changes in systems of livestock production will develop hand-in-hand. Merit buying will become more common. All-season farrowing of hogs and year-round lambing will equalize market receipts.

Yes, possibilities for change are tremendous. Just *how* tremendous is the story that will unfold in the future.

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**AGRICULTURAL RESEARCH SERVICE**
**United States Department of Agriculture**

Growth Through Agricultural Progress

*Bigger and more Specialized*

# FAMILY FARMS in 1975

*Operators will control management and speed adoption of labor-saving and output-increasing techniques*

■ Family farms will be bigger and more highly specialized in 1975—and they will continue to dominate our Nation's agriculture.

This conclusion comes from a recent analysis, by ARS agricultural economist H. L. Stewart, of prospective changes in farming during the next 15 years. The analysis was based in part on data obtained in a larger USDA study to assess the job of agriculture and agricultural research in meeting future needs. (See also AGR. RES., February 1961, p. 3).

Findings indicate that farmers will continue to step up adoption of labor-saving and output-increasing techniques. They will purchase additional equipment needed for more complete mechanization of crop production and livestock feeding operations. They will also hire more services, such as spraying, dusting, and fertilizing, and obtain more professional management assistance, including help in buying and selling livestock.

Greater use of these production materials and services will help farm operators to increase the size of their enterprises—without losing their control of management.

Changes in size of farm enterprises between now and 1975, the agricultural economist believes, will vary considerably, depending on type of operation and geographic location.

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(*Continued*)

Dairy farms will continue to increase in size and decrease in number. Many small herds will gradually be absorbed by dairymen able to invest the extra capital necessary to meet stricter sanitation requirements and to obtain advantages of larger scale operation. Even so, Stewart believes, dairying in 1975 will still be largely a family-operated business.

Exceptions will be those having unusual location and specialization advantages, such as the drylot dairies in southern California. A few dairy farms may be integrated with a feed business, whose primary interest is maintaining feed sales volume.

Average number of cows on family-operated dairy farms may increase 25 to 30 percent by 1975. This is about the same percentage increase that occurred during the past 15 years. Farms with stanchion barns will probably average 30 to 35 cows, and farms equipped with loose housing may average as high as 40 to 50 cows.

Dairymen in the Northeast will probably intensify forage production at the expense of grain production and buy more concentrates. In the Midwest, they will likely increase production of forages and grains.

Other livestock farmers also will take advantage of labor-saving techniques and specialization to reduce unit production costs. Stewart says, however, that reductions in unit costs usually tend to level out within the size range of family farms.

USDA studies, for example, have shown that unit costs on a large-scale livestock farm are only 5 percent lower than such costs on a comparable 1-man farm. In an Illinois Agricultural Experiment Station survey in northern Illinois, optimum use of land, labor, and capital was found on farms of 260 to 339 acres.

### Hog, rather than beef, production may expand in the Corn Belt

In the Corn Belt, limited forage supplies will encourage some livestock farmers to expand hog production rather than beef production. Labor requirements, as well as capital and managerial limitations, will prevent expansion to the 1,000 or more hogs that one man *can* raise. But 500 to 600 hogs per farm (compared to an average of 170 today) may be commonplace by 1975. Hog producers will increase feed grain supplies by shortening crop rotations and using more fertilizer. But they will need to buy additional concentrates.

Corn Belt farmers not in position to expand hog production may put greater emphasis on beef cattle in an effort to increase efficiency and meet market demands for uniform quality of products. Other farmers in the area may discontinue all livestock enterprises. Many of these operators will take off-farm jobs and shift to cash-crop production as a part-time operation.

Cattle ranches, Stewart believes, will change less in the next 15 years than Corn Belt livestock farms, because ranchers are already highly specialized and have few production alternatives. But these primary producers of feeder cattle will need to increase volume of business and develop uniform product quality to meet specifications of order buyers and contract feeders.

Large-scale livestock feeding will become increasingly important in the West and Southwest, where expanding markets coincide with abundant supplies of livestock, feed grains, and supplemental forage. But the size of these enterprises will be checked somewhat by managerial limitations and associated risks and uncertainties. Farm-sized feeding operations will continue to predominate in the Midwest because of the availability of farm-grown feeds and otherwise unmarketable operator and family labor.

### More contract production expected in broiler and egg industries

Vertical integration will almost surely dominate the broiler and egg industries. Production in 1975 will be largely under contract—with producers providing labor, housing, and equipment, and contractors making many of the managerial decisions.

Size of broiler flocks may increase as much as four-fold by 1975. Egg-laying flocks will probably average between 6,000 and 10,000 birds, and many egg producers may stock as many as 35,000 to 50,000 birds.

Cash-crop farms of 1975 will be affected primarily by market limitations and by financial risks associated with yield uncertainties. Mechanization has greatly increased the size of crop-farm a family can handle. But major cost reductions, beyond those now possible with a balanced set of mechanized equipment, are more limited than is sometimes supposed. For example, an Iowa Agricultural Experiment Station study showed a Corn Belt cash-grain farm of 240 acres is large enough to allow significant cost reductions.

Specialized wheat farms will probably change less by 1975 than any other major type of farm. Large-scale drylot cattle feeding enterprises are attracting considerable attention in some wheat areas, where farmers are growing feed grains on excess wheat land. The agricultural economist doubts, however, that livestock production will become a primary enterprise on wheat farms in the foreseeable future.☆

*They were 4 to 8 times more effective than a commercial compound used against downy mildew in laboratory experiments*

# New Fungicides On TRIAL

■ A new family of quaternary ammonium compounds, the phenacridiniums, show marked effectiveness under laboratory and greenhouse conditions as protectants against downy mildew of lima beans—and the chemicals might be effective against other plant diseases.

This is the first reported use of these compounds in plant disease control. The compounds were synthesized and studied for clinical use by industry and appeared promising as preoperative and laundry sterilants in hospitals, and against a wide range of bacteria and fungi affecting man and animals.

However, medical adaptation of the compounds has not been exploited because of the indelible yellow stain left when used. This staining characteristic is not objectionable, however, from the concentrations used for plant disease control, according to USDA scientists.

ARS tests of the compounds on plants are being made by pathologist B. C. Smale and physiologist J. W. Mitchell at the Agricultural Research Center, Beltsville, Md.

### They are being tested on other diseases

The parent compound—phenacridane chloride [9-(p-*n*-hexyloxyphenyl) - 10 - methylacridinium chloride]—and several close relatives were from 4 to 8 times more effective in laboratory tests than one of the commercial fungicides used against downy mildew. The scientists are now investigating the effectiveness of the compounds against other crop diseases such as anthracnose of snap beans.

The compounds are fungicidal (spore killing) rather than fungistatic (spore growth arresting) in their action. Although phenacridane chloride and certain relatives are effective in protecting lima bean plants from infection, they do not appear effective in curing plants that already have downy mildew.

Variations in the molecular structure of closely related phenacridiniums may explain their differing effectiveness, according to Smale and Mitchell. Those possessing hydrocarbon chains of 6 to 10 carbon atoms, such as phenacridane (6 carbon atoms), were most effective.

Besides good fungitoxicity, some of the compounds display other desirable characteristics for plant fungicides. All active compounds studied have surfactant properties (ability to wet leaf surfaces) and some have low water solubility (may result in high retention on leaf surfaces during rain).

### Quaternary compounds have several uses

Other quaternary ammonium compounds are used for weed control (AGR. RES., April 1960, p. 10), as dyes, in chemical analysis, as sterilants, and antiseptics in human and veterinary medicine.

Although the new compounds appear promising in laboratory and greenhouse studies, research is continuing to determine their effectiveness under field conditions. No recommendations for use of phenacridinium compounds on edible crops are made.☆

*The phenacridiniums protected lima bean plants (right) from disease, but untreated plants (left) were killed. Plants in center were treated after becoming diseased, but the new fungicides couldn't cure them.*

*Microscopic coccidial parasites hatch quickly from the cyst after being treated with an enzyme and bile.*

# WE'RE GAINING ON COCCIDIOSIS

*Basic findings might lead to control by use of drugs within a host or enzyme-like substances outside*

■ Effective coccidiosis control in livestock may result from basic research that explains the hatching mechanism of this parasite.

These studies are the first in which scientists induced hatching of coccidial cysts by treating them with an enzyme and bile.

Coccidiosis develops in animals or poultry only when microscopic egg-like coccidia cysts hatch in specific areas of the host's digestive tract. Triggering this, say USDA parasitologists J. C. Lotze and R. G. Leek, are: (1) Enzymatic action on the cyst wall in the upper part of the host's digestive system; and (2) activation of the parasites by bile in the small intestine.

Their findings indicate possible control *within* the host, using drugs to interfere with the cyst-triggering action. Or it might be possible to use enzyme-like substances to destroy protective coverings of the parasite *outside* the host.

Time for the enzymatic action to take place, the scientists discovered, is vital in coccidiosis infection. Digestive juices in the upper digestive tract prepare the cysts for hatching soon after they reach the small intestine. Otherwise the parasites will not hatch. The rumen of cattle, sheep, and goats, crop of birds, and upper part of the stomach of nonruminant animals may serve as suitable areas to prepare the cysts for hatching.

### Hatching was first studied in sheep

Lotze and Leek made their discoveries when duplicating certain conditions under which the parasite normally hatches in the host. They first studied natural hatching of the parasite in sheep.

The researchers suspected that a constituent of bile triggered the process. Hatching was started by incubating infective coccidial cysts many hours in the bile of sheep, goats, swine, rabbits, cattle, chickens, or turkeys. Further research showed that human or sheep saliva, or a commercially prepared enzyme called steapsin, caused changes in the cysts. These changes allowed the parasites to start hatching minutes after the cysts contacted the bile.

Coccidiosis affects all poultry and livestock. Although the research was done primarily with sheep, Lotze and Leek believe the results probably apply to all higher vertebrate hosts of the parasite. Although it's believed coccidia affecting sheep don't attack other animals, it's possible, the scien-

*Coccidiosis caused the wool to break from sheep being held by parasitologist Lotze (right). His associate, parasitologist Leek, holds uninfected sheep.*

tists say, for one animal to carry infective cysts on its feet or body—if not through the digestive tract—to susceptible hosts.

Coccidial parasites attack various organs, but more commonly live in the lining of the intestine and destroy parts of it. This causes diarrhea, or scours, and metabolism interference. Severely affected animals become unthrifty, fail to grow, and often die. In sheep, the disease may also cause wool-breaking—the wool fibers become thin and readily break off at the skin.

Coccidia are transmitted in cysts through droppings of the host. The parasite in the cyst is free-living, microscopic in size, and at first somewhat rounded. The cyst wall consists of a very tough membrane or membranes, protecting the parasite and enabling it to survive a long time outside the body of the host.

### Parasite divides within the cyst wall

Coccidia passed from an animal to the ground do not become infective until going through sporulation. During the sporulation process, the parasite divides within the cyst wall and forms 8 sporozoites. This takes from 1 to 14 days or longer, depending on species of coccidia and environmental conditions.

For more than 50 years, scientists suspected that trypsin, an enzyme of the pancreas, triggered coccidia hatching in higher animals. A recent study indicated that the outer layer of the cyst wall had to be cracked or broken before trypsin could enter. It was then assumed that the cyst wall became broken—either from changes in moisture outside the host, or from muscular action of the digestive tract within the host.

The ARS scientists' experiments at the Agricultural Research Center, Beltsville, Md., present a plausible hypothesis for the natural mechanisms involved in hatching of the parasites.☆

## In the Average Dairy Herd

# CROSSBREDS OFFER ADVANTAGES

■ Crossbred dairy cattle—because of superior hardiness—live, and produce, longer on the average than comparable purebreds.

Scientists attribute crossbreds' superior hardiness to hybrid vigor—the phenomenon of an offspring's increased vitality inherited from parents of widely differing genetic backgrounds.

In a USDA-Illinois experiment, 44 of 63 crossbred cows (Holstein-Guernsey) survived 6 lactations. But only 31 of 65 purebreds performed that well.

Twenty of the purebreds died or had to be removed before completing 2 lactations. Only 9 crossbreds failed within that period. The average U.S. dairy cow completes just over 2 lactations.

This means that a herd of crossbreds should lose only about half as many animals due to weakness and disease as a comparable purebred herd. So the owner of a crossbred herd may cull, on a planned basis, many more animals to improve his herd.

The crossbreeding experiments are being conducted by State dairy population geneticist R. W. Touchberry and ARS dairy husbandman F. N. Dickinson at the Illinois Agricultural Experiment Station, Urbana.

Because of these studies, they believe owners of average dairy herds might well consider using crossbred animals to improve herd longevity and health. For breeders of purebred cattle, however, the economics of losing breed identity might more than offset advantages from using hardier crossbred cattle.

Crossbreeding—because of the hybrid vigor phenomenon—appears to be a practical genetic way of appreciably increasing length of productive life in dairy cattle. According to the scientists, efforts to breed for longer life in purebreds fail mainly because heritibility of longevity is practically zero. Genetically similar animals don't pass on their long-living traits to offspring (Agr. Res., January 1960, p. 14).

Animals that died from accidental causes weren't included in the research data. But those removed because of sterility, disease, or deformity were. Also included were still-born calves that survived at least 7 months of pregnancy.

Losses of purebreds from reproductive trouble (such as sterility) were much higher than among crossbreds, and were the largest cause of the higher purebred losses.

Between 1 year and calving age, reproductive difficulties caused most of the losses among both groups. Over half the losses prior to calving age, however, resulted from failure to survive birth or inability to withstand common calfhood diseases.☆

*Knox is the most popular of soft red winter wheats. It matures early and resists leaf rust.*

*Quick acceptance of Omar, a club wheat that has much smut resistance, helped cut 1959 smut incidence in club wheat to record low level.*

Varieties that are more dependable, and have increased pest and disease resistance, are now the most popular

# *New Wheats* ARE QUICKLY

■ Wheat varieties topping the list in popularity among growers have changed dramatically since 1954, according to a USDA survey. New varieties, some in existence only 4 to 7 years, lead in acreage planted to durum, club, hard red spring, and soft red winter wheats.

In replacing old varieties, farmers have adopted wheats which are more dependable, more disease- and insect-resistant, and equal or superior in quality to those grown previously.

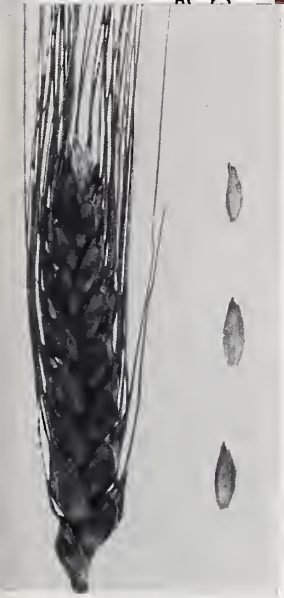
The rapidity and extent of the changeover reflects the outstanding cooperative research being done by State and USDA scientists to improve wheat by breeding for high quality and better disease and pest resistance.

Wheat surveys, taken at 5-year intervals by USDA since 1919, determine the distribution of wheat varieties and classes in the U.S. The last survey (based on 1959 figures) showed 212 varieties of wheat seeded. About 45 varieties were reported that had not appeared in previous surveys; 36 varieties that were grown in 1954 did not appear.

In 1959, 16 varieties were grown on more than a million acres each—comprising more than 70 percent of the total U.S. wheat acreage. Three leading ones—Triumph and Wichita (hard red winter) and Selkirk (hard red spring)—were each grown on more than 5 million acres.

## DURUMS

The most dramatic shift in varieties occurred in plantings of durum wheat. This type of wheat is the major contributor to the macaroni industry. Langdon and Ram



*The most dramatic shift occurred in durums. Langdon accounts for much durum acreage.*

*Selkirk, hard red spring variety, became popular mostly because of its resistance to stem rust, especially Race 15B.*

# CCEPTED

sey, released in 1956, accounted for 85.8 percent of the total durum acreage.

Langdon and Ramsey resulted from a crash breeding program by ARS and the North Dakota Agricultural Experiment Station, Fargo, to prevent losses from stem-rust disease Race 15B. Because of resistance to Race 15B and good agronomic characteristics, Langdon and Ramsey were readily accepted by farmers.

Durum wheat, partly because of its late maturity, had borne most of Race 15B's attack. This stem-rust disease infected durum wheats first in 1950. The disease caused 65 percent crop loss in 1953 and caused 75 percent loss in 1954.

Durum wheat is grown mainly in North and South Dakota and adjacent areas of Montana and Minnesota.

## CLUB

In the club wheats—a subclass of white wheat grown mainly in Washington, Oregon, and Idaho—disease also was the key factor in the variety shift.

Omar, a red-chaffed white club wheat released in 1955, is highly resistant to smut and now comprises 83.6 percent of all club acreage. It was developed cooperatively by the Washington station, Pullman, and ARS.

In addition to resistance to all known races of common bunt (stinking smut) and high resistance to several races of dwarf bunt, Omar has good agronomic characteristics and yields high-quality flour. Club wheats are used for pastry flour only.

Due to the rapid adoption of Omar by farmers and the use of chemical seed treatments (AGR. RES., June 1960, p. 5), smut incidence in 1959 was the lowest on record. Wheat grading smutty dropped to 0.5 percent from a high of 34 percent as recently as 1955.

## HARD RED SPRING

Selkirk, released in 1953, has shown phenomenal increase in popularity. In 1954, it comprised 0.1 percent of the acreage. Now, 50.9 percent of the total hard red spring wheat acreage is seeded to Selkirk.

Resistance to current races of stem-rust—especially Race 15B—is the main reason for Selkirk's rapid spread. It has good agronomic characteristics and acceptable grain quality. Hard red spring wheat is a good bread-type grain and is used in bakery flours.

Selkirk was developed in Canada and tested cooperatively by Canada, ARS, and State stations. It is grown mainly in North and South Dakota and Minnesota.

## SOFT RED WINTER

Knox, a variety released in 1953, leads in popularity with 23.8 percent of the acreage seeded to this class of soft red winter wheat. In 1954, Knox comprised only 0.1 percent of the total.

Knox and its sister variety Vermillion are the result of a 30-year effort to develop early maturing, leaf-rust resistant, soft red winter wheats with good agronomic characteristics. Vermillion is planted on 9.4 percent of the soft red winter acreage.

Both were developed and released by the Purdue station, Lafayette, Ind., in cooperation with ARS. These varieties yield well, have excellent test weight, good standing ability, short and resilient straw, are nonshattering, and have high resistance to leaf rust and soilborne mosaic diseases. Both have good soft wheat milling and baking qualities. Soft red winter is made into pastry flour and is for general household use.☆

# LEARNING ABOUT GROWTH REGULATORS

*Basic research may give us chemicals that are effective, inexpensive, and practical to use*

■ What are the chemical, physical, and physiological characteristics of growth retardants? In addition to tailoring plants, what other effects might the chemicals have? What parts of a plant respond to the chemicals? Which plant species is affected by which retardant?

These and other questions are being studied by ARS plant physiologist N. W. Stuart and horticulturist H. M. Cathey. From these basic studies they hope to find chemicals suitable for growth-controlling treatments that are effective, inexpensive, and practical for overtall crop plants, flowers, trees, and shrubs.

The researchers have tested the reactions of 55 kinds of plants to 3 growth retardants at USDA's Agricultural Research Center, Beltsville, Md. The chemicals—Amo–1618, phosfon, and CCC—have emerged as the most promising of the retardants.

Most of the experimental plants responded in several ways to one or more of the chemicals. The most obvious physiological reaction was reduction of stem length—the space between the nodes (joints) on stems was shortened. Growth of flowers, leaves, seed, and roots was affected in varying ways, but generally their size was not affected.

Few plants responded to Amo–1618—although bean, chrysanthemum, salvia, and holly were some of the genera affected in the experiments.

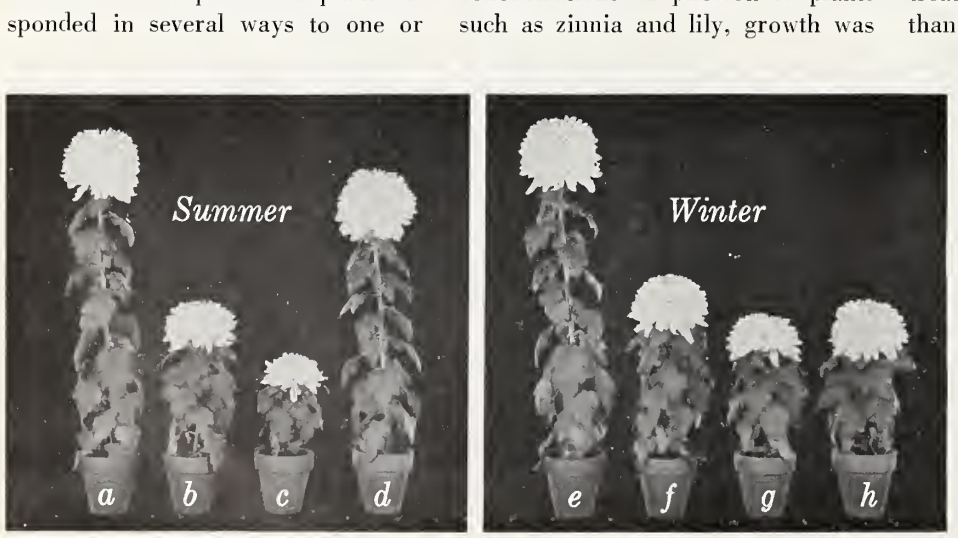
Phosfon retarded the growth of all species affected by Amo–1618 as well as of others, such as coleus, lily, red maple, marigold, and petunia. Overtreatment with phosfon often stunted and inhibited growth of plants, and, in some cases, induced chlorosis (lack of chlorophyll) and burned edges of lower leaves. On several plants, the chemical's affects were reversed. When Stuart and Cathey applied low concentrations of phosfon to plants such as zinnia and lily, growth was stimulated. The reason for this response is still a mystery, according to the scientists.

The growth of most plants was retarded by CCC—including poinsettia and hydrangea (unaffected by Amo–1618 and phosfon). Notable exceptions were petunia (retarded by phosfon) and foliage plants, such as Philodendron and Dieffenbachia, which showed no response to even massive amounts of the chemical. Overtreatment with CCC initially induced chlorosis, but the plants regained green color—in contrast to permanent bleaching by phosfon.

### Amo–1618 and phosfon persisted longest

Other behavior characteristics of the chemicals were noted. For example, Amo–1618 and phosfon persisted in soil for more than 5 consecutive crops. CCC was active for only one crop or less. Also in summer Amo–1618 was slightly more active, phosfon much more active, and CCC much less active than in winter in retarding growth.

*Seeds* exposed to the growth retardants were delayed in germinating, but germination itself was normal. *Root* development was retarded, but the effects were not apparent in plants at flowering. Most of the *leaves* of treated plants were much darker green than those untreated.




*Activity of chemicals differs from season to season. In summer CCC (d) is less active than in winter (h). Phosphon (c) is more active in summer than winter (g). Amo–1618 (b) is slightly more active in summer than winter (f). Plants (a) and (e) received no treatment with chemicals.*

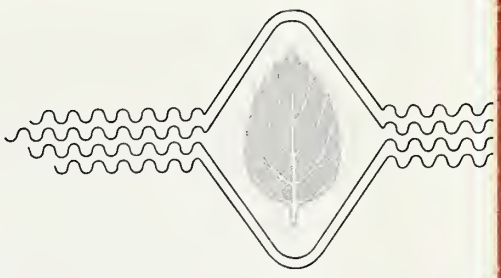
Although the rate of leaf blade expansion was slowed, the leaves eventually were similar in size to those of untreated plants. The *flowering* time and size of blossom were not noticeably altered in such plants as poinsettias and carnations. However, treatment beyond that necessary for moderate reduction of stem length usually delayed flowering of such plants as geranium and chrysanthemum. Azaleas reacted to CCC and phosfon in exceptional fashion. Vegetative growth was temporarily suppressed and flower buds formed promptly.

In the experiments, the chemicals were applied as amendments and drenches to soil. Dosages of Amo–1618 and phosfon were 0.16, 0.8 and 4 grams per cubic foot of potting soil. For CCC, 4, 10, and 20 grams of chemical per cubic foot of soil were added. Dosages considered maximum or minimum to retard growth varied throughout the year and from plant to plant.

### Treating containers may be best method

Tests indicate that the clay pot in which phosfon-treated soil is placed will absorb the chemical and release it to subsequent plantings of chrysanthemums. If clay pots are dipped in a 10 ppm solution of phosfon for 5 seconds, growth of untreated plants in untreated soil in the pot is retarded. Similar results are obtained from soaking peat pots for at least 1 hour in solutions containing phosfon. Treatment of containers may be the most effective way ultimately of applying the chemical to potted plants.

Phosfon [tributyl-2,4-dichlorobenzylphosphonium chloride] is commercially available for use on chrysanthemums. Both Amo–1618 [4-hydroxy-5-isoprophy-a-methylphenyl trimethyl ammonium chloride, 1-piperidine carboxylate] and CCC [(2-chloroethyl) trimethyl-ammonium chloride] are still experimental.☆



## A Faster Test for

# Wilt Resistance

A new greenhouse method for measuring *Verticillium* wilt resistance in mint promises to speed development of resistant varieties of commercial peppermint. And the method may be useful for measuring wilt resistance in other host crops.

It enables scientists to rapidly screen selections in the greenhouse for satisfactory field resistance to the soil-inhabiting fungus. Previous techniques of screening were successful only with either very high or very low levels of resistance. And identification of intermediate levels required years of extensive field tests.

The new technique—control of soil temperature and manner of inoculating plants with the disease pathogen—allows accurate and repeated measurement of six levels of resistance in various mint selections. Developers of the method are S. Z. Berry and C. A. Thomas, ARS plant pathologists at USDA's Agricultural Research Center, Beltsville, Md.

*Verticillium* wilt has forced 10,000 to 15,000 acres out of peppermint production since 1940. About 65,000 acres of this specialty crop are grown annually in the U.S. The disease also affects potatoes, tomatoes, cotton, and many other crops.

Plant resistance as a means of wilt control in peppermint has not been utilized previously because of the critical flavor requirement of the mint oil industry.

Attempts to transfer the high resistance of the mint species *Mentha crispa* into peppermint were successful, but all the highly resistant hybrids produced also inherited the poor oil quality of *M. crispa* and were not usable.

Spearmint, a mint species with intermediate resistance, has successfully replaced peppermint on much *Verticillium*-infested acreage. From this, the scientists concluded that use of hybrids or other mint selections of intermediate resistance and better oil quality than *M. crispa* may be feasible in breeding programs.

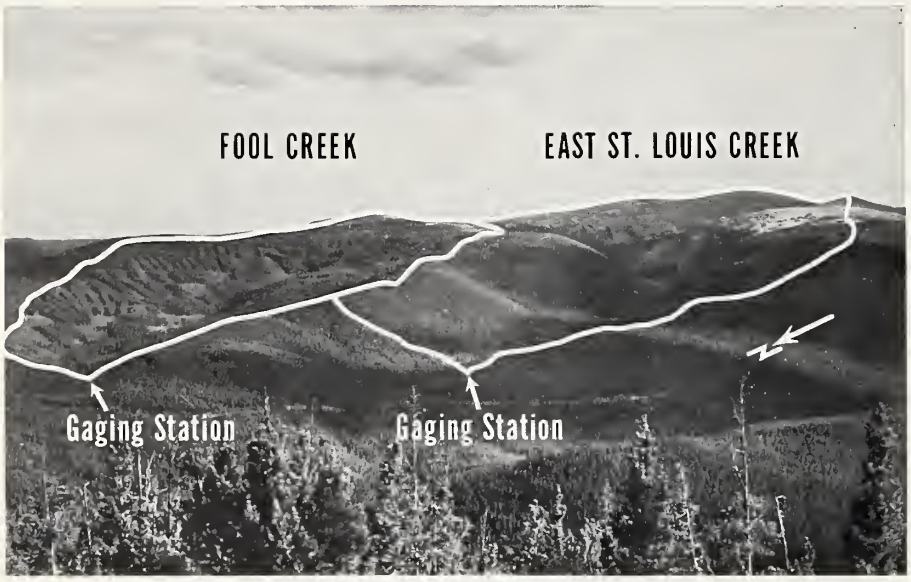
In the experiments, Berry and Thomas inoculated rooted cuttings of test hybrids and selections with the wilt fungus. The plants were placed in either steamed (noninfested) soil or infested soil in containers, then put in controlled temperature tanks at 20°, 25°, or 30° C.

Under these experimental conditions, plants displayed six distinct levels of resistance—ranging from susceptibility in commercial peppermint, through intermediate resistance in spearmint selections, to high resistance in *M. crispa*.☆

Foresters Show How

# Strip-Cutting Increases Water Yields

*Removing trees near the timberline increased runoff almost 25 percent*




*Nearly half the trees were removed from Fool Creek watershed. The East St. Louis Creek watershed wasn't disturbed. Runoff was measured at each of the gaging stations.*

*Cleared areas in the forest allow snow to reach the ground, instead of being intercepted by tree branches. Snow in open melts faster, an asset during years when midwinter thaws may reduce spring runoff peaks.*

■ Forestry research conducted on a Colorado mountain illustrates how more water might be made available in Western semiarid areas.

By strip-cutting to remove about half the trees on a small watershed near the timberline, USDA foresters increased runoff nearly 25 percent.

This study in an experimental forest near Fraser, Colo., pertains *only* to high-altitude forests with dense stands of mature timber. Such forests offer the best opportunity for increasing water yields by vegetation management in the West.

The experimental area contains 250-year-old trees—mostly lodgepole pine, Engelmann spruce, and subalpine fir. The forest is at an elevation of about 10,000 feet.

Cut strips in the forest allow snow to reach the ground, resulting in less moisture loss. When snow collects in trees, wind, tree warmth, and the sun cause evaporation losses.

Strip-cutting appears to be the most satisfactory method of removing trees to increase runoff. Selective thinning in such high-altitude forests allows gale-force winds to damage timber. Trees on the edges of strip-cuts may also be damaged, but the wind can't penetrate dense stands to cause injury.

Researchers find that most snow gathers in strip-cuts no wider than 2 to 10 times tree height. The most stream water has come from cuts 2 to 5 times tree height. Late-season water yields have been increased by narrower cuts, which are shaded more effectively than wider cuts.

Two adjacent watersheds are being

studied. The Fool Creek watershed, a 714-acre drainage, was strip-cut. East St. Louis Creek watershed's 1,984 acres weren't disturbed. Since each watershed's runoff forms its own creek, accurate measurements and comparisons can be made.

### Spring peaks may be higher than desired

Although water yields from Fool Creek have been significantly increased by strip-cutting, a potentially undesirable effect in some years has been higher spring peak flows from the watershed. Often, however, midwinter thaws can *reduce* spring peaks because of faster melting during the winter on the logged watershed.

A managed watershed that yields more water for a longer time in the spring and summer—without high spring peaks that might cause flooding—would be most desirable. Most of the water yield increase from Fool Creek occurs during May and June, but there's also a small increase in summer and early fall months.

There has been little erosion on this watershed, because of inherent stability of the soil and careful logging road construction, location, and log skidding. To confirm their belief—based on plot observations—that erosion wouldn't be a difficulty, researchers built a sediment catch-basin below the Fool Creek gaging station. The yearly wet sediment yield has averaged only 1.5 cubic feet per acre of watershed.

Other areas of the country with less stable soils would surely have much erosion loss from strip-cutting half the trees from a watershed, so this research is considered applicable only in similar mountainous areas. Most such areas are located in the national forests of the West.

Fool Creek watershed lies generally on the north side of the mountain. Similar results aren't expected on watersheds that face south.

Principal purpose of the experiment is to find better ways to increase water yields. Before these findings are applied on a large scale, however, the relative needs concerning increased water yields and timber production must be studied.

Cooperative research by the Forest Service, Colorado Agricultural Experiment Station, and Colorado State University is continuing in the forest. Studies are aimed at better understanding the relationships among forests, climate, and snow.

### More information will aid management

Additional information is needed so forest management can be directed towards objectives such as higher water yields, longer time of flow, and lower spring peaks of runoff.☆

# MOAPA . . . Money-Saving Alfalfa

■ An outstanding example of the value of research is the story of Moapa alfalfa—the first spotted alfalfa aphid-resistant variety for the deep Southwest.

Moapa was developed to resist attacks of this aphid, which caused alfalfa losses of nearly $5 million in 1954, when the pest was first discovered in the U.S. Aphid damage in the Southwest was estimated at $34 million in 1955 and almost $42 million in 1956.

Only 3 years after the aphid's discovery in this country, however, farmers were able to plant the resistant Moapa variety—mainly because of close cooperative research by Federal and State scientists.

Breeding research was headed by the late ARS agronomist O. F. Smith, in cooperation with the Nevada Agricultural Experiment Station. The Arizona and California stations cooperated in testing Moapa and joined Nevada in releasing the seed. Supporting funds for Moapa's development were supplied from a forage crops regional project, sponsored by Southwestern States and the Federal government.

Insecticides are used to protect susceptible varieties from aphids. It's estimated that this method of control (3 dustings or sprayings) costs about $10 per acre each year.

At that rate, Moapa alfalfa in California, Arizona, and Nevada saves farmers more than $1½ million annually. Furthermore, acreage planted to Moapa in California (100,000 acres), Arizona (50,000 acres), and Nevada (1,000 acres) is expected to double by 1963. If so, yearly savings would amount to over $3 million.

Plant breeders developed Moapa (a synthetic variety) by selecting and progeny testing aphid-resistant plants of the susceptible, but high-yielding, African variety. Breeding work was hastened by seed increases of experimental lines in winter. Nine resistant plants were chosen. Basic seed stocks for the new variety were produced, as they are now, by growing rooted cuttings of these plants in an isolated plot and allowing natural cross-pollination to occur.

Moapa is upright-growing, nonwinter-hardy, and recovers quickly after cutting. It's moderately resistant to bacterial wilt. The variety is recommended in areas where African is best adapted—mainly in warmer sections of Arizona, California, and Nevada.☆

# Germination Stimulants to Eradicate Witchweed?

*Maybe we can use chemicals to start seedling growth, in the absence of hosts, to starve this parasite*

■ Parasitic witchweed could be efficiently eradicated—if a satisfactory, economical substance is found to make its seeds germinate independently of other plants.

If the seeds are forced to germinate in a field without host plants, seedlings of the pest will soon die from lack of nourishment.

Artificial and natural stimulants that cause witchweed seeds to germinate in the *laboratory* have been discovered by USDA and North Carolina Agricultural Experiment Station scientists. A few of the compounds will be evaluated in the *field* this year.

### Other plants provide natural stimulant

Witchweed seeds normally germinate only in the presence of plants that produce the germination stimulant, these ARS and State studies show. Corn seedlings were grown in water 5 to 10 days. Then the seedlings were removed and the solution applied to witchweed seeds. The solution, containing natural stimulants produced by the corn seedlings, caused 75 to 85 percent witchweed seed germination within 24 hours. Witchweed seeds not treated with the solution failed to grow.

A group of chemical compounds [6-(substituted) purines] were evaluated to determine if synthetic stimulants can be developed. A few of the purine chemicals caused about 50 percent germination of the seeds.

This knowledge, that artificial stimulants can cause germination, led to an intensive search—underway at the witchweed laboratory at Whiteville, N.C.—for other chemicals that might cause germination. Several show promise and will be included in the coming field evaluations.

The major reason why witchweed is so difficult to eradicate is that seeds of the plant may lie dormant deep in the soil—sometimes for years—until germination stimulating plants grow nearby.

All plants of the grass family that were tested (such as corn, sorghum, sugarcane, and crabgrass) cause germination and are parasitized. A few broadleaved plants also cause germination but aren't parasitized.

The hairy green plant may grow more than a foot high, deriving most of its nourishment from the host plant (AGR. RES., October, 1960, p. 11).

### Available controls will produce victory

Witchweed can be controlled and *eventually* eradicated by techniques currently practiced. These include cultural methods, involving the use of catch crops (plants that are parasitized) and trap crops (they cause witchweed germination but aren't parasitized), and herbicides.

Timely planting of corn—one of the crops most severely parasitized—and heavy nitrogen fertilization tend to limit witchweed damage.

Chemical controls include application of 2,4-D as a postemergence treatment to prevent witchweed seed production, and soil fumigants such as methyl bromide for use on small spot infestations. The use of fenac as a preplanting soil-incorporated herbicide also shows promise.

These methods are proving highly valuable in preventing spread of the dangerous parasite outside of North and South Carolina, where the weed is presently confined.☆

*Corn in foreground shows effect of uncontrolled parasite. Plot in rear was treated with herbicide.*

*Parasitic witchweed plant saps strength of corn by tapping host's supply of nutrients.*

## Dairy congress papers wanted

U.S. dairy scientists are invited to submit papers for presentation at the Sixteenth International Dairy Congress to be held in Copenhagen, Denmark, September 3 to 7, 1962.

The invitation comes from R. E. Hodgson, director of the Animal Husbandry Research Division, ARS, who is U.S. liaison officer for the Congress. Proposed papers should be sent to him no later than May 1, 1961, at USDA's Agricultural Research Center, Beltsville, Md. Requested are title, author's name, position, address, and Congress section for each paper.

The Congress program includes sections on milk production, liquid milk, butter, cheese, condensed milk and milk powder, dairy machinery, ice cream, control and analysis, economy and organization, and dairying in warm countries.

Five copies of each final manuscript (no more than 2,000 words) and abstract (200 words or less, written in English, French, and German) must be submitted to Hodgson by September 1, 1961.

## Hopper and cricket control urged

Now's the time for Western and Midwestern farmers and ranchers to begin watching for grasshoppers and Mormon crickets, USDA urges.

Last fall, grasshopper and Mormon cricket populations were at their lowest in recent history. And State and Federal pest-control workers stress that efforts this spring could further reduce the threat for years to come. Prompt application of insecticides offers the most economical means of preventing buildup and spread of these highly destructive pests.

The 1960 survey showed that grasshopper-infested rangelands had decreased about a million acres, but cropland infestations were slightly higher than in 1959.

Mormon crickets have their breeding grounds high in the mountains. If not controlled, the crickets band together periodically and descend on ranges and croplands. For years, ARS and State workers have watched the breeding areas and destroyed the pests as they banded. These efforts have kept infestations low and prevented spectacular mass migrations.

## Narrow cuts best in compact soil

Plowing compact soils into narrow slices is a more efficient tillage practice than cutting wide furrows and breaking up resulting clods.

ARS soil scientist W. R. Gill and agricultural engineer W. F. McCreery tested moldboard plow shares of various widths (2, 4, 6, and 8 inches) and found that narrower cuts break soil into smaller clods.

Plowing narrow strips takes more power for the initial operation than cutting wider furrows, but is more efficient in overall seedbed preparation. Clods from wide cuts must be further broken by disking or harrowing before reaching equivalent size.

Tillage efficiency can be measured by comparing the energy required in a tillage operation with the energy expended in a standardized soil-breaking procedure. This consists of dropping a 1-cubic-foot block of soil a standard distance enough times to produce the same clod sizes that result from the tillage operation.

These experiments were conducted at USDA's National Tillage Machinery Laboratory, Auburn, Ala. The results aren't considered applicable on *loose* soils, because power requirements would be much less for breaking such soil into smaller clods.

## DHIA cows return average of $84

An average profit of $84 over total estimated costs of feed and care was returned by each dairy cow enrolled in the National Cooperative Dairy Herd Improvement Association (DHIA) in 1959.

In contrast, available data indicates that the average dairy cow in the U.S. gave only enough milk to just about equal her estimated expenses during the year. This is based on the assumption that feed costs represent approximately half the total cost of producing milk.

Figures for 1959 show that on January 1, 1960, a total of 2,439,043 cows—12.6 percent of the U.S. total—from 68,687 herds were enrolled in the DHIA plans.

These included 1,746,752 cows in the Standard Record Keeping Plan, a 8.7 percent increase over 1958; 615,899 cows in the Owner-Sampler Plan, a 12.0 percent increase; and 76,392 cows in the Weigh-a-Day-a-Month Plan, a 2.1 percent increase.

Records also indicate that DHIA members are accelerating the rate of improvement in their herds. For example, DHIA cows increased average annual production from 8,907 pounds of milk per cow in 1949 to the present

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record level of 10,327 pounds. All U.S. dairy cows increased average production from 5,279 pounds per cow in 1949 to 6,438 in 1959.

Dairy record keeping, a cooperative program of USDA and the State Agricultural Extension Services, has been an important factor in U.S. herd improvement for more than 50 years. Dairy record keeping has repeatedly proved valuable for increasing efficiency and lowering costs.

## Rockefeller award for Hendricks

S. B. Hendricks, internationally known agricultural scientist, has been named to receive the first Rockefeller Public Service Award in Science and Technology.

Hendricks, chief chemist of the ARS Pioneering Research Laboratory for Mineral Nutrition of Plants, is one of six Federal employees being honored for outstanding service. The other awards recognize service in Administration, Conservation and Resources, Foreign Affairs, and Law and Regulation. Presentation of the awards will be made in Washington, D.C. later this month.

R. E. McCardle, chief of USDA's Forest Service, will receive an award in Conservation and Resources.

These awards, administered by the Woodrow Wilson School of Public and International Affairs, Princeton University, were made possible by a contribution of John D. Rockefeller III. Objectives are to recognize outstanding accomplishments of Federal workers and to assist persons so honored to make further significant contributions to strengthen the cause of public service.

Each winner will receive $3,500. In addition, he will be eligible to receive a grant of funds sufficient to enable him to make available to others some of the knowledge gained during his years of service. This may take the form of a book-length manuscript, a series of articles or lectures, or brief periods of residence at a university.

Hendricks and McCardle joined USDA more than 30 years ago. Both have received USDA's Distinguished

Service Award and the President's Award for Distinguished Federal Civilian Service. They have also been honored by many national and international scientific organizations (AGR. RES., April 1958, p. 3).

## New Hessian-fly-resistant wheat

Lathrop, a new Hessian-fly-resistant spring wheat developed by USDA and Wisconsin Agricultural Experiment Station scientists, has been released to certified seed growers.

This wheat is adapted mainly to Wisconsin, but may prove useful in neighboring States. It will be used mostly as feed but under certain conditions may be milled.

The new variety is a common bearded wheat that showed high resistance to the Hessian fly in 3 years of testing in Wisconsin, according to ARS plant breeders and entomologists. The Hessian fly lays its eggs on the leaves of young wheat plants. The larvae feed on the plants, sometimes causing extensive crop losses.

Lathrop is similar to one of its parents, Henry, a wheat used widely in Wisconsin. It resembles Henry in heading date, plant height, resistance to lodging, and in reaction to powdery mildew, leaf rust, and stem rust. It has red kernels, intermediate in texture, like those of Henry but slightly smaller in size.

Lathrop received its Hessian fly resistance from P.I. 94587, a wheat introduction from Portugal. In 15 yield tests, Lathrop averaged 31.8 bushels per acre—compared with 31 bushels for Henry, 31.4 for Russell, and 29 for Selkirk.

Seed will be available from dealers in 2962. No seed will be supplied by USDA or Wisconsin station.